CONTROLS SPECIFICATION

For

CITY COLLEGE PLYMOUTH
MARINE TECHNOLOGY CENTRE

Issued by:-

Silcock Dawson & Partners
11th Floor, Colston Tower
Colston Street
Bristol BS1 4XE
Tel: +44 (0) 117 929 4749
www.silcockdawson.co.uk

July 2020
PMTC-SDP-XX-XX-SP-M-002

Project Revision Sheet

Project: City College Plymouth - Marine Technology Centre

Project No: 200068

Prepared by: Gavin Way

Version	Date	Details	Changes	Author	Checked
T1	24-07-20	Tender Issue	-	GW	GW

Contents

W69 CENTRAL CONTROL / BUILDING MANAGEMENT SPECIFICATION 1
PERFORMANCE OBJECTIVES: 1
Design Parameters: 1
SYSTEM DESCRIPTION: 1
Points Schedule 1
Wiring 1
Controllers/control equipment 2
Local environmental controls 2
System Security 3
System Software 3
Operational Characteristics 3
Monitoring and Logging Functions 5
Graphical User Interface (GUI) 5
System Alarms 5
Commissioning 6
System Support 7
Acceptance Demonstration 7
System Hand-Over 7
Documentation 9
Learning Platform ..... **Error! Bookmark not defined.**
Analyse utility/energy consumption. (Gas, water and electricity) ..... **Error! Bookmark not defined.**
Weather Station ..... **Error! Bookmark not defined.**
Control Panels 9
Site/User Training 9
Maintenance/Building Manager 10
Warranty, Support & Maintenance Contract 10
System Parameters 10
Hard wired interlocks 11
Occupancy Hours 11
CONTROLS DESCRIPTION: 11
Start Up 11
Zoning ..... **Error! Bookmark not defined.**
Heating 11
Frost Protection 11
Night Time/Out of Hours Setback 11
Pumps 13
Boilers 13
LPHW Pressurisation Units 13
Heating Circuits 13

Secondary Heating Circuits 13
Overdoor Heaters ..... **Error! Bookmark not defined.**
Fan Convectors 14
Radiators 14
Hot Water Generation 14
Ventilation Systems 14
Cold Water Service ..... **Error! Bookmark not defined.**
Cold Water Booster Sets 14
Leak Detection System ..... **Error! Bookmark not defined.**
Air Conditioning Units 14
Gas Safety Circuits 15
Gas Valves 15
Gas Valve Position Monitoring 15
Utility & Energy Metering 15
Trend Energy Display Screen ..... **Error! Bookmark not defined.**
Trend IMAT Utility Monitoring ..... **Error! Bookmark not defined.**
Fire Alarm 15
External Lighting Control and Monitoring ..... **Error! Bookmark not defined.**

W69 CENTRAL CONTROL / BUILDING MANAGEMENT SPECIFICATION

PERFORMANCE OBJECTIVES:
The Contractor is to be responsible for the detailed design development of a complete automatic control installation associated with the mechanical and electrical services installation in accordance with the specification and drawings, including verification of design, co-ordination with other contractors and development of design to installation level detail.

Use a controls specialist to design, supply, install, test and commission complete controls installation.

Provide a DDC (direct digital control) automatic control installation to serve the building and allow safe and efficient operation of the mechanical services installation and associated environmental controls.

Design Parameters:

- BSRIA Application Guide AG2/94 'BEMS Performance Testing'
- BSRIA Application Handbook AH2/92 'Commissioning of BEMS - A code of practice'
- BSRIA BEMS Centre Application Handbook AH1/90 Volume 1 'Centre Standard Specification'
- BSRIA BEMS Centre Application Handbook AH1/90 Volume 2 'Standard Specification for BEMS ver 3.1
- CIBSE Application manual 'Automatic Controls'
- CIBSE Commissioning Code M
- BSRIA AG 9/2001 ‘Standard specifications for BMS’

SYSTEM DESCRIPTION:

The BMS control system for this project shall be a Schneider Electric System as used by the College currently and as an extension to their existing system. The Contractor shall ensure that any adjustments to the system head end are allowed for if required.

All systems shall be capable of operating independently of each other and continue to operate under failure of the BMS.

All controls must be Schneider compatible (BACnet, Modbus) with the system remotely accessed either via a web based browser for adjustment and monitoring of the system via the IP controller mounted in the control panel which will have the facility to generate data/alarms to the head end terminal and/or required maintenance staff. The controller shall be provided with an Ethernet connection for connection to the LAN.

Points Schedule

The BMS/Controls specialist shall provide a points schedule showing each proposed connected point to the system. The points shall be arranged to comply with this specification showing the points allocated on a plant-by-plant basis, the controller specification selected, I/O capacity supplied and the spare I/O available for future use. Any points schedule supplied shall be considered as supporting information and it shall be the responsibility of the BMS specialist to ensure the correct allocation of points and full compliance with this specification.

The BMS/Controls specialist shall include a further schedule summarizing the field hardware and indication of qualities, types, manufacturer and duties of devices.

Where the system comprises more than a single network, a diagram shall be supplied indicating layout of the LAN and any interconnections.

Ensure that the BMS is capable of dealing with a future 20% increase in the number of points without compromising the system's functionality or speed of operation.

Wiring

The BMS/Controls specialist shall be responsible for the design and installation of all power and field wiring from control panels to equipment.

The BMS/Control specialist shall be responsible for the design and sizing of the motor control centres which shall be provided as part of the electrical contract.

The Electrical Contractor shall provide suitably sized power supplies to the control panel.

Controllers/control equipment

All of the controllers, sensors, thermostats, emergency/safety buttons, links, and any other control equipment required to complete the scheme, shall be Trend compatible.

Local environmental controls

Local control shall be provided for teaching staff over their immediate environment for lighting, heating and ventilation. All user controls shall be tamperproof to ensure pupils cannot alter their settings; they shall be easily comprehensible and quiet in operation.

Controls shall be provided to ensure that:

- controls are clearly labelled, easy to use by untrained School staff, reliable and as far as possible automatic (while allowing for some degree of local override – see below);
- thermostats and room sensors are tamper-proof, as required by AD L;
- where specific controls are required to be operated by authorised personnel only, they shall be located accordingly
- all controls should be located so as to deter unauthorised use by Pupils.
- controls must suit the operational requirements of the Schools.
- control systems shall be provided with the facility for remote monitoring of the system.
- local control for building users should not be provided over heating temperature set-point, start time, finish time, regular day omission, or holiday days omission.
- All space temperatures sensors, air quality, external temperature, meters, plant operating conditions are recorded via the BMS.
- The specified occupant controls can be linked to, and communicate over, the BMS communications network.
- Occupant controls can control the relevant items of plant.
- The status of each occupant controller can be viewed and overridden via the operator workstation.
- Each occupant controller has a service port available that allows a laptop type computer to be connected using a suitable wired service tool. It shall be possible to disable the service port function via the password protected configuration settings for the occupant control.
- When connected using the service port all controllers in the entire BMS network are to be accessible via the laptop type computer.

System Security

The BMS/Controls Specialist shall ensure that the BMS meets the requirements of IET Code of Practice for Cyber Security in the Built Environment and that the BMS software is protected from unauthorised entry.

The BMS/Controls Specialist shall allow the appropriate credential-based operator and maintenance technician access is set up for clients, servers and field controllers.

The BMS/Controls Specialist shall manage information security of systems, software and data during design, implementation and commissioning in line with BS EN ISO/IEC 27001 and shall ensure that the BMS can be maintained by a service provider in accordance with BS EN ISO/IEC 27001 and BS ISO/IEC 20000-1.

System Software

The BMS/Controls Specialist shall ensure that the following system software requirements are met:

- Obtain on behalf of the end users all appropriate licences, permissions, copyright waivers, rights of use and the like from the owners of the software rights. Ensure that the end user is properly registered with the software supplier for support and appropriate updating. Provide documentation for application software in accordance with BS ISO/IEC 26513 and BS ISO/IEC 26514.
- Ensure that, as far as practicable, all software is commercially available off-the-shelf.
- Ensure that any programmable configuration, customisation and bespoke software is developed, tested and commissioned using relevant processes and procedures complying with BS ISO/IEC/IEEE 12207 or BS ISO/IEC/IEEE 15288, supported by a quality management system meeting the requirements of BS EN ISO 9001.
- Ensure that IT industry standard operating systems are used.
- Ensure that copies of all BMS vendor-specific software are held by an independent third party and that this software can be released to the client.

Operational Characteristics

The BMS/Controls Specialist shall ensure that the following system operational requirements are met:

- Ensure that the control of plant is independent of the operator workstation.
- Ensure that no data of a control nature is transferred between field controllers via the operator workstation, i.e. data relating to control strategies.
- Ensure that the client / server can communicate with all addressable field devices.
- Provide complete system integrity such that the network of field controllers shall continue to fully operate following a failure of the client / server.
- Ensure that the appropriate control strategy configuration data can be downloaded to all addressable field controllers.
- Provide a means of displaying and modifying each addressable field controller's control strategy, time schedules and set-points via the client / server.
- Allow the operator to re-schedule plant operation times. Ensure that re-scheduling can be applied globally to a number of items of plant at one or more sites (or one or more controllers on one site) as selected by the operator.
- Allow an operator with sufficient user privilege (e.g. Administrator access) to create, modify and delete control strategies within all addressable field controllers.
- Ensure that the client / server incorporates a data storage management system that warns against impending online storage overflow and allows for data archiving to, and retrieval from, offline non-volatile media. Ensure that the operator is prompted at pre-defined intervals to carry out the data archiving procedure.
- Ensure that it is possible to perform a complete backup of the plant control strategies, set-points and logged data to the server.

- Where neither network-attached storage (NAS), Storage Area Network (SAN) nor cloud storage are utilised for backup purposes by the system, provide an electronic data archival device that uses readily available non-volatile media that is appropriate for long term storage of system software, configuration data and logged data (including alarm data).
- Allow the transfer of data from the system memory and other storage devices to the archive mediums, and vice versa for the preparation of reports.
- Ensure that the system can be fully restored from backup data.

Monitoring and Logging Functions

- Ensure that all monitored point data can be displayed at the operator workstation. Ensure that analogue, digital and soft-points can be displayed simultaneously.
- Ensure that all changes made by the operator (e.g. set-point changes) can be logged and identified by both operator and date/time stamp.
- Provide a facility to allow the display, at the client, of 'real time' data superimposed on plant schematics and refreshed automatically as the monitored value changes.
- Ensure that a minimum of six 'real time' data points can be displayed simultaneously on one graph, in the form of data plots.
- Provide a facility to allow the monitoring and display, on the same 'page', of common criteria/plant functions.
- Ensure that any hard or soft-point log can be displayed and stored on any operator workstation.
- Ensure that logs can be set up from any client and that optional logging start and stop dates, and times are adjustable.
- Ensure that log samples can be recorded either on a polled basis, where the logging intervals are user adjustable between 1 second and 24 hours, or when the value changes by an amount greater than an adjustable hysteresis threshold.
- Ensure that the server has sufficient data storage capacity to accommodate the defined amount of logged data and that the data can be backed up.
- Provide a facility to allow the simultaneous display of different logged data. Ensure that this function is operator adjustable.
- Provide a facility to allow the export of logged data to other software packages using standard database formats (e.g. SQL, ODBC, etc)

Graphical User Interface (GUI)

The BMS/Controls Specialist shall provide a GUI to the following standards:

- BS EN 61082-1 for general schematic and information presentation
- BS EN 60073 for indications and actuator states
- ISO 7000 / IEC 60417-series, IEC 60617 and ISO 14617-series for symbols in general
- BS 1553-1 for piping systems and plant symbols and schematics
- BS 1553-2 for power generating plant symbols and schematics
- BS 1553-3 for compressing plant symbols and schematics
- BS 1635 for fire protection system symbols and schematics
- BS 4737-5.2 for the intruder alarm system symbols and schematics
- BS EN 1861 for refrigerating system and heat pump symbols and schematics

In addition, the BMS/Controls Specialist shall also provide an ensure the following:

- Provide a library of plant schematics and symbols, the format/contents of which should be confirmed with the specifier based on samples.
- Provide a facility to allow the operator to generate additional schematics and symbols using readily available drawing formats (e.g. bitmap, jpeg).
- Ensure that the system can accommodate the addition of 20% extra graphics 'pages'.
- Provide an easy to use facility to allow the operator to modify plant schematics and to generate new ones. New elements for schematics to be available on a Tool Palette, and the association with data points in controller outstations to be made using drag-and-drop.
- Ensure that graphics can be displayed in a layered approach (building layout graphics down to plant subsystems and components). Ensure that the operator can modify the structure of the layered approach.

System Alarms

The BMS/Controls Specialist shall ensure that the system is designed and installed in accordance

with the following:

- Ensure that alarms are displayed on a rolling basis in chronological order.
- Ensure that the operator can acknowledge alarms, including muting of audible or flashing annunciators.
- Provide a facility to silence audible alarms or inhibit flashing annunciators without performing alarm acknowledgement.
- Ensure that alarms can be inhibited for reasons of time and/or priority as selected by the operator.
- Ensure that the BMS can be configured to avoid fleeting alarms, i.e. ensure that alarms can accommodate start-up and shutdown delays.
- Ensure that the administrator can alter the limits at which the measured values cause alarms to be triggered.
- Ensure that alarms can be limited to the source items(s) of plant.
- Ensure that alarm limits can accommodate sliding limits, e.g. set-point changes.
- Ensure that alarms can be differentiated by means of alarm type and identification.
- Ensure that alarms can be prioritised (including a high priority that shall be annunciated regardless of other activity) and a low priority or information status that is only annunciated on demand.
- Ensure that visual, audible and printed annunciation of alarms, or any combination of these, can be selected by the operator.
- Ensure that the reception and acknowledgement of alarms can take precedence over other operations. However, ensure that the reception of alarms does not hinder user log-in.
- Allow the user to acknowledge alarms individually and on a group basis. Acknowledgement should include muting or flashing annunciators.
- Provide distinction between active alarms whose conditions are not cleared and unacknowledged alarms.
- Provide an alarm-latching facility with manual reset.
- Ensure that alarm data provides condition identity; condition value; alarm source; alarm time and date; and acknowledgement status.
- Ensure that the alarm file can be sorted by the above criteria.
- Allow alarms to be automatically redirected to other operator workstations or to individual operators regardless of which workstation they are logged on to.
- Provide sufficient data storage capability for the storage of alarms.
- Ensure that any stored alarm data can be analysed in conjunction with other monitored conditions or stored logged data.
- Ensure that an alarm review facility is available.
- Allow the display of stored alarm data based on user definable selection criteria.
- Ensure that the operator can define the requirement for acknowledgement of alarms; a time programme for annunciation of alarms to different destinations; and text messages associated with alarm conditions.
- Ensure that critical alarms can be relayed by SMS text message and/or email to a distribution list of operators. The definition of a 'critical alarm' is to be wholly adjustable by Administrators.

Commissioning

The BMS/Controls specialist shall be responsible for the full commissioning of his system and any other controls equipment supported by him in accordance with CIBSE Commissioning Code C ‘Automatic Controls’.

All safety interlocks, overrides and failsafe conditions prior to starting the plant. Demonstrate as agreed with the engineer prior to starting plant in BMS mode.

Fault conditions for all critical alarms, safety devices and interlocks shall be simulated and proved effective as soon as practical once BMS control mode is selected.

Sensors shall be checked to ascertain accuracy within limits, pressure switches checked for switch points and hysteresis. Humidity sensors shall be checked for accuracy using wet/dry bulb thermometers.

All necessary test equipment and materials used in commissioning shall be supplied by the BMS/Controls specialist. All test equipment shall have valid test certificates.

Trend graphs shall be provided to demonstrate the stable control of the plant. Simulated inputs shall be employed to check stability over the design environmental range.

The BMS/Controls specialist shall allow one additional full day by his commissioning engineer to revisit the system at a later date (after handover) for seasonal commissioning. He shall check and adjust operational parameters, and re-tune any control as may be required by change in the control system load conditions, external environment or bedding in of the plant.

Commissioning documentation and schedules shall be submitted for approval during the design phase showing each plant point, interlock and control algorithm, and the stages of checks and commissioning required. Each cleared item to have date and engineer reference. Completed copies shall be available to the engineer prior to acceptance testing. A complete set of the commissioning documentation is to form part of the system documentation.

Once any item of plant is commissioned and left running to the dictates of the BMS, documentation shall be in accordance with the BMS/Controls specialist standard templates.

System Support

The Contractor shall ensure that a viable strategy is in place to fully support the BMS for a minimum of 10 years from the date of practical completion.

Acceptance Demonstration

The BMS/Controls specialist shall give seven days notice to the engineer of his intention to provide the acceptance demonstration once the commissioning is complete. The operation of all safety interlocks shall be tested and 10% of all points shall be selected by the engineer and demonstrated for operation and accuracy. If 1% fail the engineer may at his discretion demand 100% demonstration. The BMS/Controls specialist shall supply sufficient man-power, test equipment, consumable items and portable telephones to conduct the demonstration effectively. Testing shall also incorporate an audit of the wiring and hardware installations, demonstration of safety interlocks, start of systems from power-down and review of time schedules and alarm levels, grouping and selected control parameters.

System Hand-Over

The BMS/Controls specialist shall ensure the following at handover (but not limited to):

- Any snagging shall be cleared
- All password/PIN numbers, levels and operators recorded
- Disk copies of all systems and data files supplied
- All equipment access keys handed over
- Complete set of O&M manuals left with system, any agreed amendments/additions to be completed
- Training of engineers and operators to be complete
- ensure that the controls systems are fully commissioned throughout prior to handover, and ensure that the whole building system commissioning is undertaken such that the Building Services controls systems that interact with each other are commissioned at the same time
- ensure that the Building Services control systems are commissioned in accordance with CIBSE Commissioning Code C ‘Automatic Controls’.
- provide a commissioning programme prior to construction allowing for 2 weeks’ notice prior to witness testing

- ensure that inspection and testing are undertaken in line with BS 7671:2008 ‘Requirements for electrical installations. IET Wiring Regulations’
- commission the controls system in accordance with BSRIA AG 9/2001 ‘Standard specifications for BMS’
- carry out performance testing/proving during the 12 month defects period
- The Contractor shall conduct seasonal commissioning of the control systems during the 12 months after handover (during the defects liability period) and fine tune control settings. The Contractor shall also run, monitor and maintain the systems for a minimum period of 1 week before handover.

Documentation

Two copies of all final operating and maintenance documentation (including all testing and commissioning certificates and that the certificates include the test equipment identity and certificates of calibration) shall be supplied prior to handover in A4 format. All system documentation shall be in an agreed format, the BMS/Controls specialist shall agree this format 6weeks prior to handover with the engineer.

Operating manuals shall comprise instructions on optimum control settings, equipment safety checks, start-up and close down procedures, daily operation and full descriptions of operating features. These shall match and comply fully with the software supplied, provide examples of operation with supporting flow/strategy diagrams. Diagrams shall show the full diagrammatical (network structures, outstations and peripherals) and physical layout of the system and components. Ensure that a hard copy and an electronic copy of the testing and commissioning certificates of the controls systems are submitted with each copy of the Operating and Maintenance Manuals and 'As Installed' drawings. Ensure that a hard copy and an electronic copy of the cable schedules relating to the controls system are submitted with each copy of the Operating and Maintenance Manual

Maintenance manuals shall comprise full descriptive and cleaning/maintenance details on each and every item of equipment supplied. Suppliers and spare parts references, contacts, telephone numbers, and addresses shall be supplied where relevant. Wiring schedules shall show the connection of each item of equipment top the field equipment. Data sheets and maintenance instructions shall be provided for each item of equipment. Diagrams showing the configuration of all control and monitoring schemes, identifying the modules used, their interconnections and setting parameters, copy printouts showing the individual outstation module and sequence.

Record drawings of the installation shall be supplied by the BMS/Controls specialist, based on the "As Installed" architectural backgrounds.

All drawings relating to the BMS/Controls shall be supplied in a size relevant to the type of drawing which shall be agreed with the engineer 6 weeks prior to final hand over.

Back-up copies of all system configuration files and master software disks shall be supplied in an appropriate lockable storage facility. All system and data files shall be current as at the hand-over date, disks to be suitably identified and directories and files cross referenced in the maintenance manuals. The storage unit and key shall be handed to the clients engineer at handover.

The Contractor shall provide a Building User Guide which includes a user friendly description of all controls and an overview of the controls philosophy. It shall include a short illustrated guide for the room user for each type of space e.g. classroom, hall, practical space, describing how to control the ventilation, lighting and heating that can be handed to the user of the space. The Building User Guide shall be provided in hard copy and electronic format.

Control Panels

Control panels shall be wall mounted type with front panel switches for motor drives: HAND/OFF/AUTO.

When in AUTO mode a signal shall be sent to the BMS for automatic control.
The control panel shall be provided with lamp indications as follows:

- RUN — Green Lamp
- TRIPPED — Red Lamp
- PANEL LIVE (Each section) — White Lamp
- SUPPLY ON (Packaged plant) — White Lamp

All control panels shall be provided with fascia mounted MP-C display with operator interface.

Refer to drawings for locations of the control panels.

Site/User Training

The BMS/Controls specialist shall provide the following training for the schools maintenance staff:

- General maintenance staff (may be third party)
- Off site prior to hand-over at manufacturers works; non-specific system structure, components and applications
- Operation of user terminals, keyboards, use of displays, overrides and passwords
- On-Site; specific system structure, outstations locations, control strategy overviews. Operation of user terminal, adjustments, trend graphs and alarm handling. Other network components. The functioning/calibration of the installed energy sub-metering.

Maintenance/Building Manager

Off site prior to handover complete training courses at manufacturers works, instructions in the following; all as above but also including, configuration of outstation and user terminal's software, Windows/DOS file structures, password and engineering utilities, tuning and maintenance.

On-site; while the clients engineer shall attend the acceptance demonstrations, the BMS specialist shall instruct him in the specific application of the system, the structure and the control strategies adopted to meet the specification.

Warranty, Support & Maintenance Contract

Any warranty period or limit of liability shall be strictly in accordance with the main contract conditions.

Following hand over the following post contract support shall be provided for twelve months, the cost for which shall be deemed to be included within the BMS/Controls specialists order for the works.

- Central Service Logging
- 24 hour technical help line
- 24 hour emergency remote response within 2 hours of call logged
- 24 hour on site response

Following the completion of the defects period the BMS/Controls specialist may wish to provide the school with a maintenance contract; this shall be agreed during the defects period.

System Parameters

BMS controls systems shall be installed, comprising all automatic controls, control panels BMS hardware and software necessary for the enabling and monitoring of the following installations:-

- Boiler control system (enable only)
- LTHW system temperatures
- Pumps (enable only)
- Mechanical Ventilation Heat Recovery Units (MVHR) and VRF system via central controller (monitor only)
- Comms room cooling (monitor only)
- CAT 5 booster set
- Pressurisation Unit
- Compressor (monitor only)
- Fan Convectors (enable only)
- Electric metering
- Heat metering

The BMS shall include control and monitoring of the following:

- Optimised heating by enabling and disabling the boilers and secondary heating pumps based on readings from master internal and external thermostats.
- LTHW VT flow temperatures based on readings from external thermostats.
- Temperature and time clock control to all heating and HWS services.
- Provide an over ride facility to all zones
- Time clock control to the integral anti legionella regime for the HWS storage tanks.

- Time clock control for the secondary HWS circulation pumps.
- Night setback and frost protection
- Weekly run regimes for all fans and pumps to ensure that they are occasionally enabled
- Logging and reporting of all sub-meters including gas, water, electricity.

Hard wired interlocks

Provide hard wired interlocks for the following system plant groups:

- Fire alarm signal (to shut down LTHW heating and ventilation plant)
- Boiler high and low pressure switches
- Gas/CO detection
- Emergency gas shut off button
- Gas solenoid valve position
- LTHW system pressurisation unit
- DHW high temperature limits
- Fire/smoke dampers

Occupancy Hours

Occupancy hours for the School shall be agreed with the Contract Administrator.

CONTROLS DESCRIPTION:

Start Up

The building/s are occupied and used intermittently. The operation of all mechanical service systems shall be governed by a programmable timer to initiate and shutdown on a daily basis, to account for weekend periods, statutory holiday periods and any other start/stop periods as defined by the user.

The start/stop operation for each system and constituents shall be sequenced over time to ensure simultaneous power consumption is maintained below an optimum level.

Heating

The heating start time shall be optimised to ensure operative temperatures are met prior to occupancy of the building.

Start up of the heating system shall depend upon demand being present as registered by space sensors, immersion sensors etc.

Frost Protection

A two stage frost protection shall be provided based for the heating system as follows:

a. Enable the heating pumps in the event that the external temperature drops to 5°C (this temperature shall be adjustable);
b. in the event that the temperature drops to below 2°C, (this temperature shall also be adjustable) then the second stage of frost protection commences and the heat generating plant circulates the heating medium around the system;

Night Time/Out of Hours Setback

If the space temperature falls below a 12°C set point out of normal hours, measured from the communal space temperature sensor the BMS shall operate the emitters and heating system to meet 12°C set point in order to mitigate the risk of condensation and damage to the building fabric. This set point figure shall be adjustable by the end user.

Weather compensation

The LTHW variable temperature (VT) heating system shall modulate via operation of a 3-port mixing valve according to the weather compensation control and the heat curve set in the BMS system.

Pumps

The BMS shall enable the boiler controller (and primary shunt pumps from the controller) and secondary circuit circulation pump.

- All pump operations shall be subject to differential pressure sensing between suction and discharge to determine that the pump is running.
- Differential pressure above set point shall imply pump running status.
- Pump running/failed status shall be remotely indicated.
- If pressure differential is detected below set point, after a post initiation elapsed time, the BMS shall perform a duty/standby changeover operation.
- If pressure differential is detected below set point after a post changeover operation elapsed time, both pumps shall shutdown and a remote alarm raised.
- Once the secondary pumps are established as running the BMS shall enable boiler start with operation via a return temperature sensor on the secondary circuit.

Boilers

Heating shall be provided by two gas fired boilers, each capable of 67% total load, to operate in lead/lag mode. The BMS shall monitor accumulated total run hours of each boiler. Once a total run hours set point for the lead boiler is reached the boiler control shall changeover the boilers lead/lag status.

Total run hours of each boiler shall be remotely indicated.

Each boiler package shall be provided complete with a self contained control system which shall, on initiation by the BMS system, fire the burner, prove the gas supply and supply and maintain LTHW at a flow temperature of 80°C delivered to the low loss primary circuit to ensure a temperature of 80°C is delivered to the secondary circuit.

The boiler control system shall export to the BMS all monitoring activity and raise a common fault alarm in the event of a boiler failure.

LPHW Pressurisation Units

The pressurisation unit shall be permanently live, fed from the motor control panel and shall be a packaged unit provided with a self contained controls system and monitored via the BMS for fault

Heating Circuits

The heating system consists of both a constant temperature LTHW F&R circuit and variable temperature LTHW F&R circuit.

Constant return temperatures shall be maintained by variation of flow in response to variation in demand.

Accordingly, the pumps shall be inverter driven, capable of modulating flow rate to maintain a constant temperature difference between the flow and return of the loop.

LTHW flow and return temperatures shall be continuously sensed and remotely monitored.

On start up, the building pre heat process shall be managed in two operations:

- To obtain operating temperatures across the primary circuit, the secondary circuit shall be closed (from previous heating period shutdown) and the return water temperature set point raised.
- Once the primary circuit temperatures are achieved, the primary circuit return water temperature set point is dropped to its normal setting and each secondary circuit control system is initiated, in a sequential order over time.

Secondary Heating Circuits

The constant temperature secondary circuit shall be two port valve and TRV controlled variable flow governed by aggregated space temperature. The pump shall be variable speed governed by a sensed pressure control regime.

The variable temperature secondary circuit shall be TRV controlled variable flow governed by aggregated space temperature. Pumps shall be variable speed governed by a sensed pressure control regime.

All sensed values of temperature and pressure to be monitored and remotely indicated.

All items of rotating equipment to register run/stop/trip/duty/standby status and remotely indicate.

Fan Convectors

Fan Convectors shall be provided with integral control and local controller (and associated temperature sensor) for on/off control with BMS enable (for out of hours operation) and provided with EC motors and 2 port control valves or TRVs as standard.

Radiators

Control of the radiator output shall be via local TRVs and fed from the weather compensated circuit.

Hot Water Generation

The hot water calorifier shall be provided with integral control to operate the local 2-port motorised zone valve to enable flow of CT LTHW to the coil based on the stored temperature of the clinder.

Ventilation Systems

MVHRs

The specified units shall be provided with a local wall mounted controller (combined with the VRF system to maximise efficiency) with fan speed control via the CO_2 sensors.

MVHR units shall be provided with local control enabled either via the master controller (as specified) or via the BMS (if an alternative is proposed and accepted) and shall be monitored for common faults via the BMS in the event of failure.

All ventilation systems shall shut-down in the event of a fire alarm signal being received either via the control panel or local contactors.

Fire Alarm Interface

All ventilation systems shall shut-down in the event of a fire alarm signal being received either via the control panel or local contactors.

Cold Water Booster Sets

The CAT 5 booster sets shall be provided with integral control and be monitored via the BMS for fault.

Air Conditioning Units

Rooms served via the VRF system shall be provided with local wall mounted controllers (**Note:** The design currently includes for a combined air conditioning and ventilation controller. Should the Contractor offer alternatives, the control may have to be split) for occupant control. The local controllers shall be connected to a master system controller which shall be monitored by the BMS for common fault.

The Comms room shall be provided with a local wall mounted controller, monitored via the BMS for

common fault.

Fault alarms shall be generated on the BMS via a ModBus interface.

Gas Safety Circuits

Gas Valves

The solenoid valve feeding the plant room gas supply shall close should any of the following occur:

- Fire alarm activated
- Emergency knock off operated
- Gas sniffer operated
- CO sensor operated

Gas Valve Position Monitoring

Fault lamps situated in the local control panel shall indicate that the local gas valve is in the closed position and an alarm shall be generated on the BMS. **NOTE:** All the safety interlocks above are hardwired and operate in all modes of control.

Utility & Energy Metering

The BMS shall monitor and log utility meters (capturing 1/2 hour, 24 hour, weekly totals, monthly totals, accumulative total and 15min usage rate). Energy meters shall be provided for all plant items rated above 50kW.

Meter Details

- Heat Meters
- Electric utility meters via Mod Bus
- Main incoming meter
- All LV distribution boards electric meters

Fire Alarm

A fire alarm activated signal shall be provided at each control panel by an addressable relay installed by the Electrical Contractor.

The addressable relay shall be configured such that it only operates on evacuation and not on test. In event of the fire alarm being activated all plant shall be disabled immediately.